Friday, November 03, 2017 1:39 PM

Circular Motion and Gravity

big idea: $a=v^2/r$ for uniform circular motion
$F_{net}= ma = mv^2/r$

if you move in a circle, $v=d/t$ $d= 2\pi r/T$ T is the period
sub in $v^2 = (2\pi r/T)^2 = 4\pi^2r^2/T^2$

$\boxed{F_{net}=ma=mv^2/r= m4\pi^2r/T^2}$ directed towards the centre of the circle

If the object is moving in non-uniform circular motion:

$F_c=ma_c =mv^2/r= m4\pi^2r/T^2$

F_c and a_c are the components towards the centre of the circle.
(there is also the tangental components, F_t a_t)

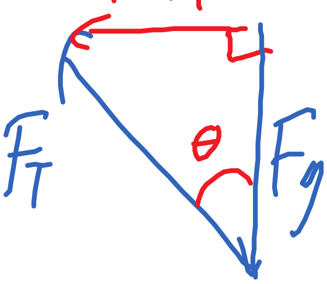
Next class: flying pig lab:

Theory:

Free body

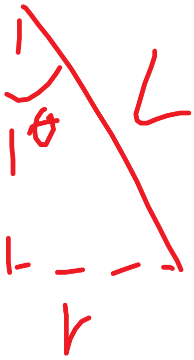
* No $F_c \equiv F_{net}$

$$F_{net} = \frac{m4\pi^2 r}{T^2}$$



$$\tan\theta = \frac{F_{net}}{F_g}$$

Vector Addition



$$\sin\theta = \frac{r}{L}$$

Small θ, $\sin\theta = \tan\theta = \theta$

$$\frac{\cancel{m}a}{\cancel{m}g} \approx \frac{r}{L}$$

$$\frac{4\pi^2 \cancel{r}}{T^2 g} = \frac{\cancel{r}}{L}$$

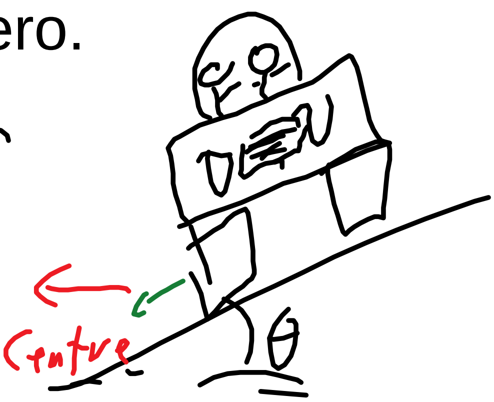
$$\boxed{T^2 = \frac{4\pi^2 L}{g}}$$

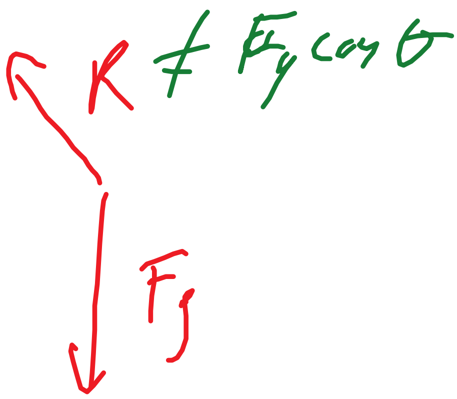
$$\boxed{T = 2\pi\sqrt{\frac{L}{g}}}$$

going back to tanθ=Fnet/Fg = a/g
who recognizes that?
Marco: tanθ=a/g = v^2/rg is the banking equation

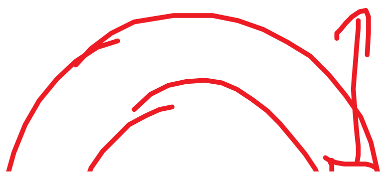
Banking is where you slope a road or tilt a bike into a turn. If you bank just right, the friction on the road that is required reduces to zero.

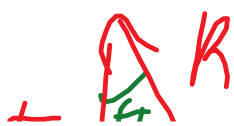
front view of car



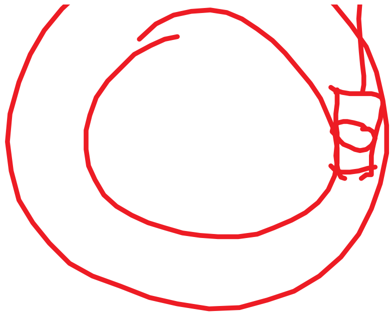


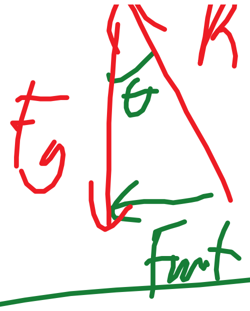
top





top view





$$\boxed{\tan\theta = \frac{ma}{mg} = \frac{a}{g} = \frac{v^2}{rg}}$$

Orbits – $F_g = \frac{GMm}{r^2}$

$$\boxed{F_g = F_c}$$

$$\frac{GMm}{r^2} = \frac{mv^2}{r} = \frac{m4\pi^2 r}{T^2}$$

p121-122 Q17-33 odds

$$s = \frac{1}{2} g t^2$$

$$T = \sqrt{\frac{2s}{g}}$$

$\frac{1}{1}$ g_F

$$\approx \frac{1}{6} g_E$$

$$T = \sqrt{6}\,\sqrt{\frac{2s}{g_E}}$$

t_{earth}